FIFTEENMILE BASIN
HABITAT IMPROVEMENT PROJECT

1992 ANNUAL REPORT

By

Gary M. Asbridge

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Christopher V. Brun

Mt. Hood National Forest
Barlow Ranger District
Dufur, Oregon

Prepared for

Andy Thoms, Project Manager
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
Agreement Number: DE-AI79-84 BP16726
Project Number: 84-11

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Steve Jones	Hydrologist Technician Mt. Hood National Forest Hood River Ranger District
Francis Nelsen	Biological Aide Mt. Hood National Forest Barlow Ranger District
Greg Koonce	Fisheries Biologist Inter-Fluve Bozeman, Montana

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ABSTRACT

USDA Forest Service, Mt. Hood National Forest activities, funded by Bonneville Power Administration, in the Fifteenmile Creek Basin during 1992 focused on fisheries habitat improvement in Ramsey Creek. A walking excavator built 40 fisheries habitat improvement structures in a 0.7 mi reach, and a professional tree faller dropped 60 trees in a 1.3 mi reach directly upstream. We targeted logged corridors from an earlier timber sale for treatment in both reaches. Other, USDA Forest Service funded, projects in the basin included fisheries habitat improvement in Middle Fork and South Fork Fivemile Creeks, campground rehabilitation designed to improve riparian zone conditions, and road obliteration projects totaling 22 miles. Basin monitoring programs proceeded according to schedule.

The number of steelhead trout redds counted upstream from the Mt. Hood National Forest boundary was slightly lower than in 1991. Steelhead are spawning more in Fifteenmile Creek than other streams within the basin inside the Mt. Hood National Forest. Water temperatures peaked earlier than previous years and remained high through summer, likely reflecting drought conditions. Fisheries habitat improvement structures placed in Fivemile Creek by hand in 1991 required more maintenance than those built by a walking excavator in Middle Fork Fivemile Creek; however, structures in both creek were functioning as designed. Based on a cross sectional transect survey we found greater mean site depths and maximum site depths after project implementation within the 0.7 mi reach in Ramsey Creek. In retrospect, our stated objectives should have been tied to numeric values, such as pool depth, to make them easier to monitor. Post project habitat surveys are planned for the Ramsey Creek project reach in 1993. We will determine after this survey whether project objectives were met.

INTRODUCTION

The Fifteenmile Creek Basin habitat improvement project is a multi-year fish habitat improvement effort aimed at increasing numbers of wild winter steelhead trout *Oncorhynchus mykiss* in the basin. Cooperators in this improvement program are the Oregon Department of Fish and Wildlife (ODFW) and USDA Forest Service, Mt. Hood National Forest (USFS), in consultation with the Confederated Tribes of the Warm Springs Indian Reservation (Tribes) and Wasco County Soil and Water Conservation District. The majority of the project is funded by the Bonneville Power Administration (BPA) under the Northwest Power Planning Council's Fish and Wildlife program (Measure 703(C), Action Item 4.2). Fifteenmile Creek and its major tributaries, Eightmile, Fivemile, and Ramsey Creeks, support the easternmost population of wild winter steelhead trout in the Columbia River Basin. The winter steelhead run is depressed relative to historic and estimated potential production levels (Smith et al. 1987) and is an ODFW and USFS stock of concern.

Steelhead production in the Fifteenmile Basin is limited due to lack of low flow rearing habitat (Smith et al. 1987). Factors that affect the quantity and/or quality of salmonid rearing habitat include passage barriers, high summer water temperatures, low summer flows, lack of habitat diversity, channel instability, and sediment loading. Past enhancement efforts in the basin were designed to correct these problems and consisted of passage improvement projects (both upstream and downstream), riparian fencing, instream structure construction, and erosion control on federal, state, and private lands.

Work on USFS land has primarily targeted fish habitat improvement using instream structures and improving up and downstream passage. However, in recent years the USFS has emphasized an increased holistic watershed approach in this, and other, basins; projects designed to reduce erosion from roads, cut banks and campgrounds have been implemented. Instream structures were placed in Ramsey Creek during 1986, 1987, 1988, and 1992, Fifteenmile Creek during 1989 and 1990, and Fivemile and Middle Fork Fivemile Creeks in

1991 using BPA funds. USFS funds were used for habitat enhancement work in Eightmile Creek at Eightmile Crossing Campground in 1987 and 1991, Middle Fork Fivemile Creek in 1992 and South Fork Fivemile Creek in 1992. Before 1992 USFS had treated 2.0, 3.0, 0.5, 0.2, and 0.8 stream miles using instream structures in Ramsey, Fifteenmile, Eightmile, Fivemile, and Middle Fork Fivemile Creeks, respectively. Upstream passage in Ramsey Creek was improved in 1983 by removing one culvert at RM 8.4 and modifying another at RM 11.1 by installing baffles. A rotating fish screen was placed in the Wolf Run irrigation ditch (off of Eightmile Creek) in 1990.

USFS and ODFW are conducting ongoing spawning, stream habitat, and fish population surveys, as well as water temperature and macroinvertebrate monitoring. These activities will help estimate current and potential anadromous fish production and evaluate progress towards meeting habitat enhancement objectives.

Tasks addressed in 1992 as outlined in the Clackamas/Hood River Habitat Enhancement Project 1992/93 Statement of Work and Budget are outlined below. Tasks were completed on schedule unless otherwise noted.

Objective 1: Baseline Basin-wide Monitoring in Coordination with the Oregon Department of Fish and Wildlife

Task 1.1: Conduct spawning surveys on National Forest land as a relative indicator of population status and trends.

Task 1.2: Macroinvertebrate monitoring; analysis conducted by Dr. Fred Mangum, Aquatic Ecologist, USFS, Region 4.

Task 1.3: Double macroinvertebrate sampling using a private aquatic invertebrate specialist who is less expensive. Compare analyses results with Mangum's to determine relative cost effectiveness.
NOTE: Double sampling was not conducted in 1992 and is not planned in 1993.

Task 1.4: Water temperature monitoring.

Objective 2: Fifteenmile Creek Habitat Improvement

Task 2.1: Monitor habitat improvement project in the mainstem of Fifteenmile Creek (RM 44.4-47.4).
NOTE: Fish habitat structure evaluations will be conducted by district fisheries personnel. Post-project habitat surveys will occur during spring 1993.

Task 2.2: Maintain log structures placed during 1989 and 1990.
NOTE: Cursory evaluations conducted by district fisheries personnel indicated maintenance was not needed in 1992. Comprehensive 1993 surveys (see Task 2.1) may indicate otherwise.

Task 2.3: Survey Fifteenmile Creek upstream from previous project work to the upper limit of anadromous fish production (approximately RM 47.4-50.0) to determine future habitat improvement needs.
NOTE: A basin level survey was completed in 1991 that should identify future project needs. The report is in preparation.

Objective 3: Fivemile Creek Habitat Improvement

Task 3.1: Maintain log structures (if needed) placed in 1991.

Objective 4. Ramsey Creek Habitat Improvement

Task 4.1: Complete project planning and environmental analysis report for habitat improvement work in a 2.75 mi reach from RM 8.25-11.0.
NOTE: Partially completed in 1991. Project area length was modified after planning to a 2.0 mi reach (RM 8.5-10.5).

Task 4.2: Pre-project monitoring in the project area.

Task 4.3: Prepare and award heavy equipment and helicopter contracts.

Task 4.4: Implement habitat improvement project.

Task 4.5: Write annual report.

Other USFS activities in the Fifteenmile Basin, funded with USFS dollars, during 1992 included: habitat improvement projects in South Fork Fivemile and Middle Fork Fivemile Creeks, interpretive sign design and construction for the Eightmile Creek Interpretive Trail (partially BPA funded), campground maintenance in Eightmile Crossing

Campground designed to restore riparian vegetation and reduce erosion, and road obliteration projects totaling 22 miles.

PROJECT AREA DESCRIPTION

The Fifteenmile Creek Basin, located in north central Oregon, drains a portion of the northeast corner of the Mt. Hood National Forest (Figure 1). Fifteenmile Creek is a fifth order, class I tributary to the Columbia River, entering the Columbia just downstream of The Dalles Dam (RM 192). The basin encompasses approximately 373 mi^2; the upper fifth (71 mi^2) lies within the Mt. Hood National Forest, Barlow Ranger District. Headwater elevations in the basin range from 6200 ft for Fifteenmile Creek to 4200 ft for Ramsey Creek, drop to 2500-2200 ft at the forest boundary, and approach sea level (72 ft) at the Fifteenmile Creek mouth. The stream flow regime is characterized by high spring runoff from melting snow pack combined with spring rains, followed by low summer flows. Water quality in the basin is generally good, and the water is relatively productive with moderate to high biomass potential (ODFW, unpublished data).

Two surface irrigation diversions are located within the Mt. Hood National Forest. One diversion is located in Fivemile Creek 200 ft upstream from the forest boundary and consists of a small wooden dam with a four inch PVC pipe diverting an unknown quantity of water. The other diversion, Wolf Run Ditch, originates from Eightmile Creek at RM 29.7 (Eightmile Crossing Campground). A rotating screen was placed in the ditch in 1990. Most water is pumped out directly from streams within the basin below the forest boundary (ODFW and Tribes 1989).

Fish habitat within USFS land was generally rated as fair to good in the early to mid 1980's (Godbout and Uebel 1982; Kinzey and Hutchinson 1985), depending on the stream and reach. Negative factors influencing habitat capability included lack of low flow rearing habitat, locally limited spawning habitat, irrigation diversions or withdrawals, siltation, and

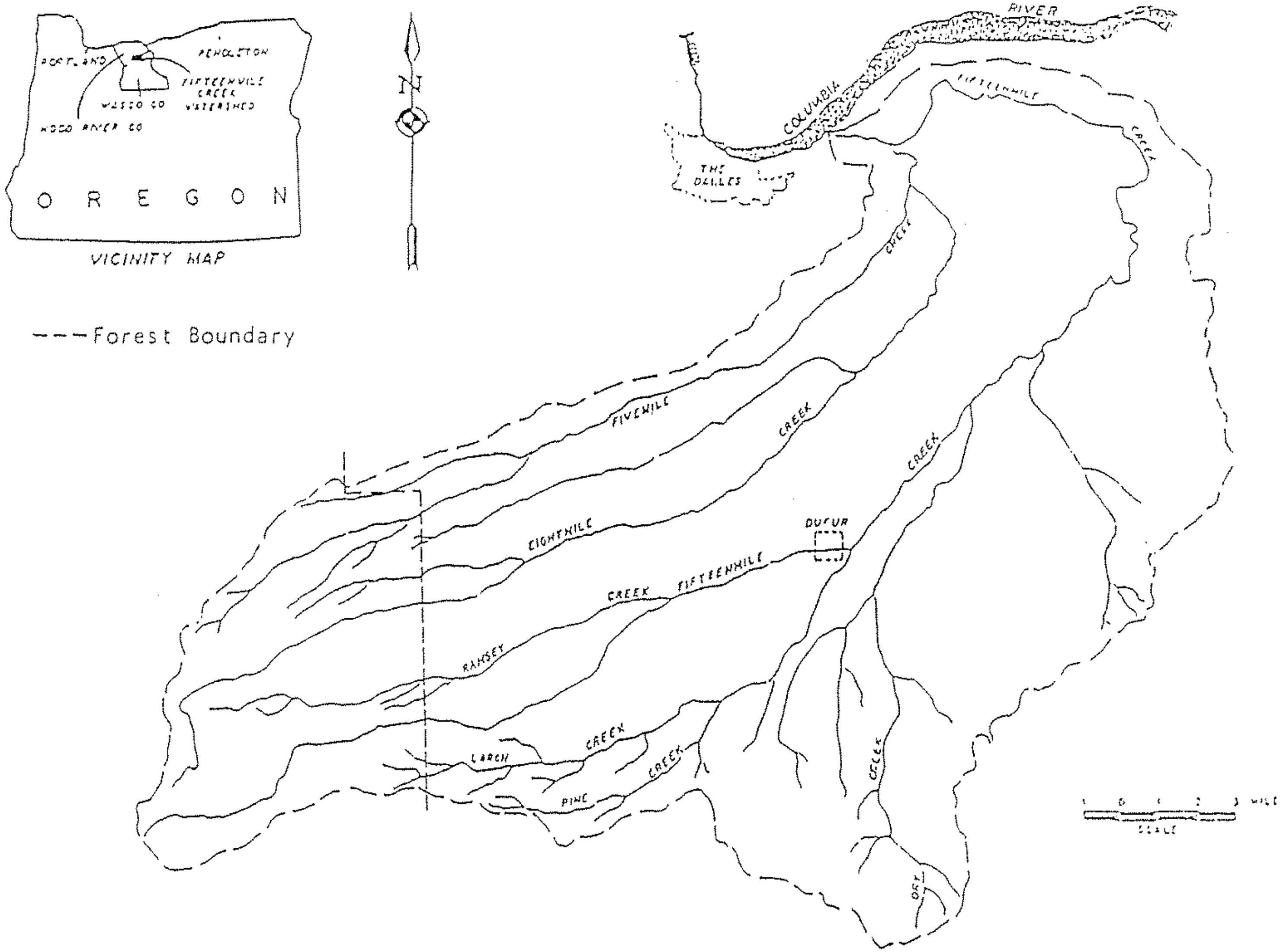

Figure 1. Fifteenmile Creek Basin located in Wasco County, north central Oregon.

passage obstructions. Detailed descriptions of the basin and discussion of limiting factors may be found in the Fifteenmile Basin Implementation Plan (Smith et al. 1987), draft Fifteenmile Creek Sub basin Salmon and Steelhead Production Plan (ODFW and Tribes 1989), and USFS stream survey reports (Godbout and Uebel 1982; Hohler et al. 1985; Higgins and Forsgren 1986; Grimes 1987 and 1988; Sheldon and Shively 1989; Vos et al. 1989a, 1989b).

The Fifteenmile Creek Basin on forest is classified as a special emphasis watershed in the Mt. Hood National Forest Land and Resource Management Plan (Plan). This classification places a higher value on riparian and aquatic habitat, as well as water quality, rather than other resources. Management activities may occur, including timber harvest, but activities should be designed to bring the watershed closer to the desired future condition outlined in the Plan.

Besides steelhead, other cold water fish found in the basin include resident rainbow trout, cutthroat trout *O. clarki*, and sculpin *Cottus sp.*. Warm water tolerant fish exist in the lower third of the basin below the forest boundary and include suckers *Catastomus sp.*, northern squawfish *Ptychocheilus oregonensis*, and dace (family Cyprinidae) (Smith et al. 1987).

The USFS portion of the Fifteenmile Creek Basin Project has been divided into four components:

*Ramsey Creek
*Fivemile Creek
*Eightmile Creek
*Fifteenmile Creek

For detailed descriptions of Eightmile, Fifteenmile, and Fivemile Creeks refer to previous annual reports (Cain and Asbridge 1989; Asbridge 1990; Asbridge and Brun 1991).

Ramsey Creek Drainage

The following summary of habitat conditions in the Ramsey Creek drainage and project reach is taken from USFS monitoring and evaluation reports by Sheldon and Shively (1989) and Bergamini et al. (in preparation).

Ramsey Creek is a class I, third order tributary to Fifteenmile Creek and originates at Puma Springs, northeast of Mt. Hood. Approximately one half of the drainage, from RM 7.5 to 14.5, is located in the Mt. Hood National Forest. There is a moderate potential for soil/slope failure in the natural state; erosion potential in the drainage is low. Logging corridors, 30 to 50 feet wide, occur at regular intervals from the forest boundary upstream to forest road 4450 (RM 7.5 - 11.1). Most of the overstory vegetation and instream woody debris has been removed from these logging corridors.

The 1992 project reach extended from RM 8.4 to 10.5 (Figure 2). A previous fisheries habitat improvement project was implemented during 1988 in the lower 0.7 miles of the 1992 project reach (section one). The remaining 1.4 miles (RM 9.1 - 10.5, section two) had not been treated in the past. Stream classification for the project reach is B3 (Rosgen 1985).

Prior to project implementation, habitat composition in section one was 61% riffle, 31% pool, 5% glide, and 2.5% side channel. In section two the composition was similar: 60% riffle, 33% pool, 5.6% glide, and 1% side channel. Dominant substrate in both sections was sand/silt (particularly in pools) followed by small gravel in section one, large gravel and rubble in section two. Visually estimated mean depths ranged from 0.1 m to 0.3 m for riffles and pools, respectively. Measured maximum depths were 0.4 to 0.8 m in glides and pools, respectively. Amount of cover varied depending on habitat unit type; however, virtually all habitat units had some type of cover. Overlapping cover, a measure of cover (and habitat) complexity, within habitat units was lacking. Large woody debris (LWD) levels were

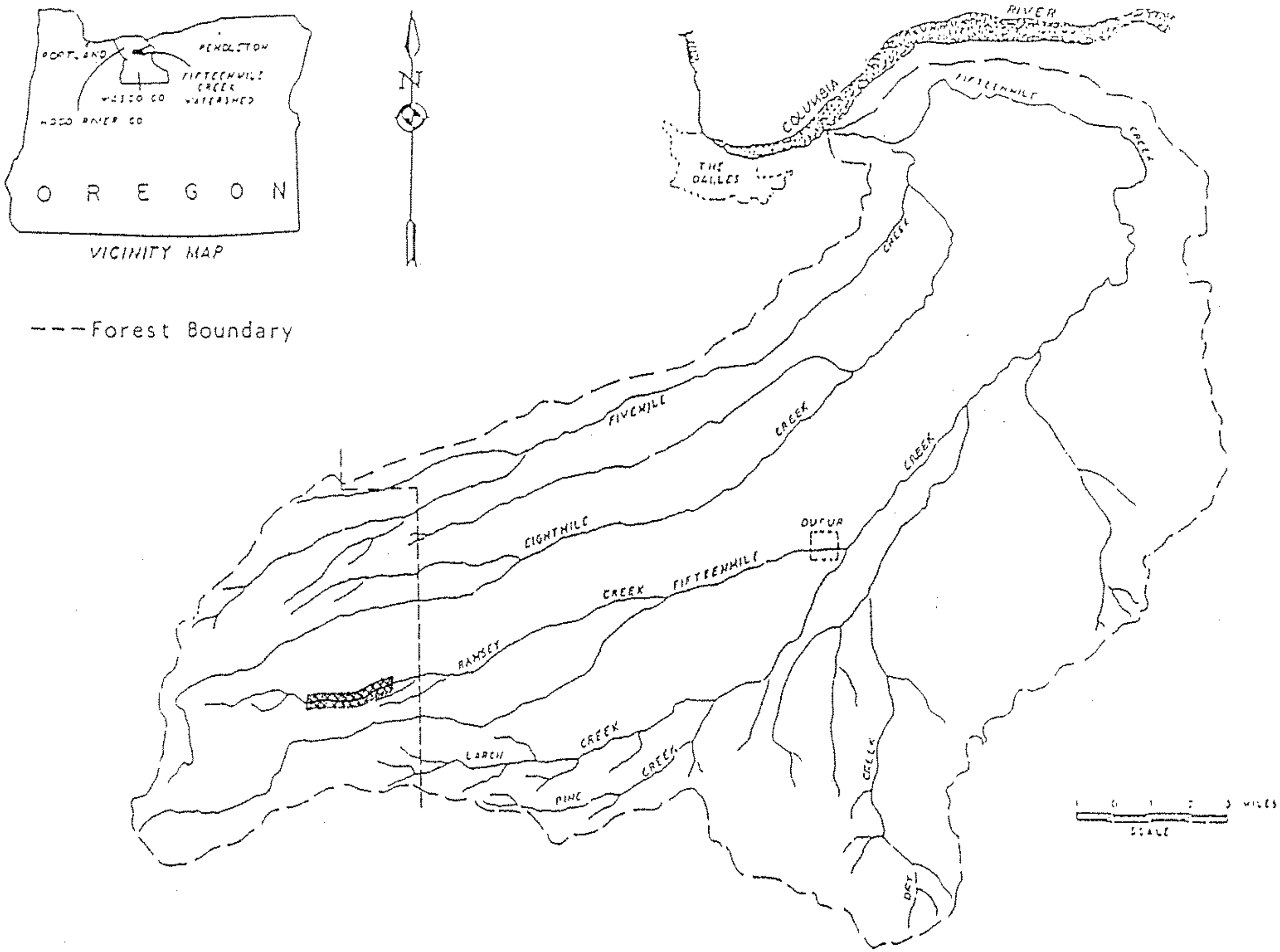

Figure 2. Location of 1992 BPA funded fisheries habitat improvement work in Ramsey Creek.

approximately five pieces per 100 m of stream, below the minimum standard outlined in the Plan.

Surveyors snorkeled approximately 20% of the available habitat within the project reach in 1992 before project implementation. In general, 0+ rainbow/steelhead (trout) were found in glides, main channel pools and low gradient riffles about equally; 1+ and legal sized trout targeted main channel and lateral pools followed by glides and riffles. There was a tendency for larger trout to be near natural wood in the stream channel, but all trout used substrate, depth, and undercut banks to some degree. Age 0+ trout were also associated with stream margin habitat.

METHODS AND MATERIALS

Spawning Surveys

Spawning surveys in the Fifteenmile Creek Basin, within the Mt. Hood National Forest, were conducted during late April and early May 1992 in Ramsey, Fivemile, Middle Fork Fivemile, Eightmile, and Fifteenmile Creeks (Figure 3). USFS personnel also surveyed a portion of Fifteenmile Creek below the forest boundary. The number of redds and adult steelhead trout were tallied during each survey. Redd locations were marked with flagging.

Macroinvertebrate Monitoring

Three samples were taken at each of five sites three separate times in 1992 (spring, summer, and fall) for a total of 45 individual samples. Sampling procedures and site locations (Figure 3) are described in the 1986 annual report (MacDonald and Hutchinson 1987). Samples were preserved in 10% alcohol and shipped to Dr. Fred Mangum (Aquatic Ecologist, USDA Forest Service, Region 4) for analyses.

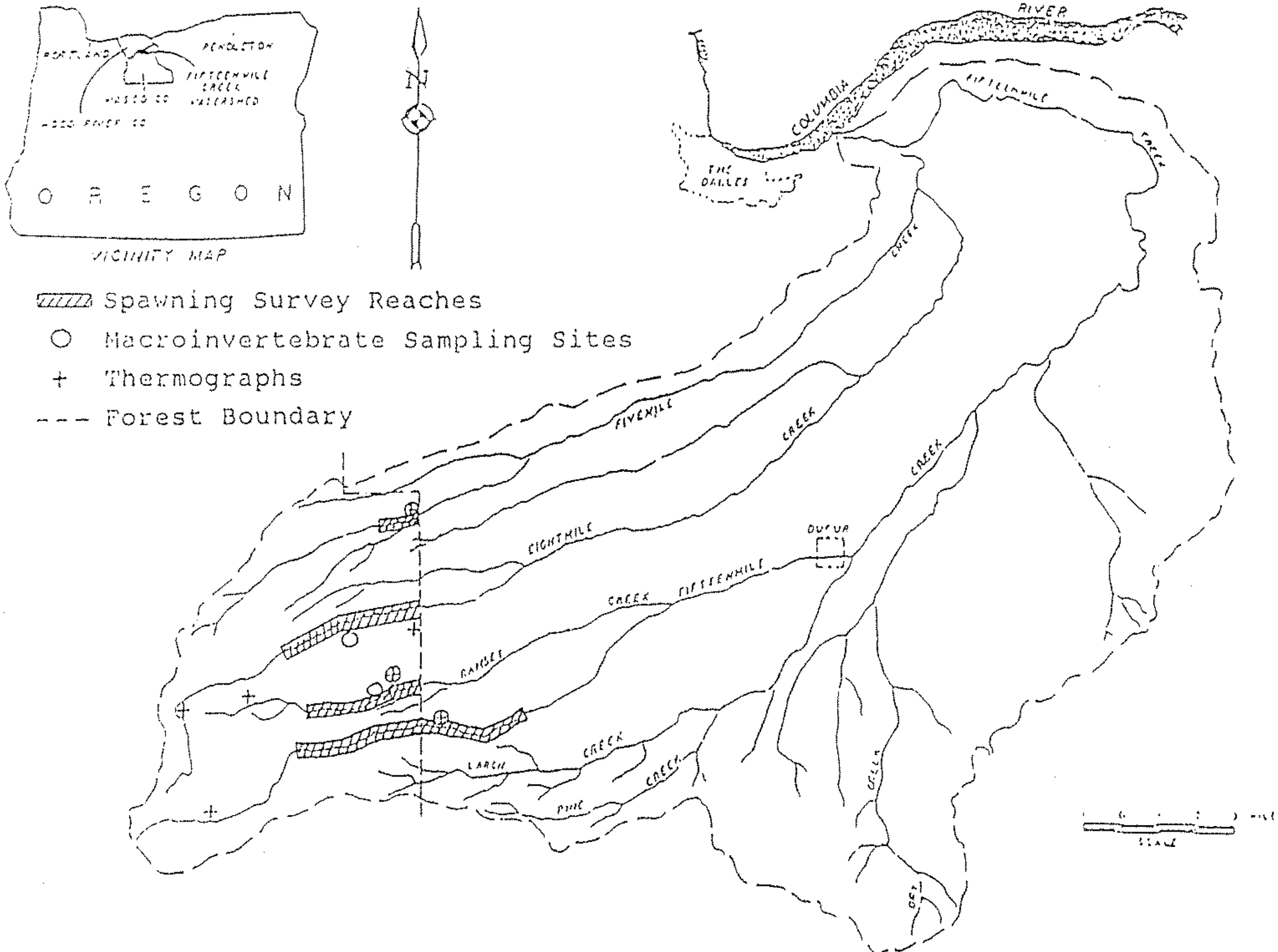

Figure 3. USFS spawning survey stream reaches, macroinvertebrate sampling sites, and thermograph locations in the Fifteenmile Creek Basin, 1992.

Water Temperature Monitoring

Omnidata Datapod[1] electronic temperature recorders (thermographs), programmed to record the temperature every hour, were placed throughout the basin to monitor temperature changes. USFS personnel placed thermographs in the headwaters and at, or near, the USFS boundary in Fifteenmile, Eightmile, and Ramsey Creeks and at the USFS boundary in Fivemile Creek (Figure 3). Thermographs were in place from April through November. USFS personnel inspected thermographs at least once a month for data chip or battery failure and to compare thermograph accuracy with a hand held thermometer. Temperature data were downloaded to a computer where daily and monthly maximum, minimum, and mean temperatures were calculated.

Physical and Biological Monitoring

Pre-project monitoring was conducted in the 1992 Ramsey Creek project reach using a modification of the Hankin and Reeves (1988) methodology (Sheldon and Shively 1989). Monitoring objectives were to gather baseline fish habitat and population information, monitor pre treatment conditions, and help identify factors limiting salmonid production. A post-project survey in section one to monitor results from the 1988 habitat improvement project, conducted in July 1992, served as a pre-project survey for the 1992 project in that reach. Section two was surveyed for the first time in July 1992. In addition, we established photo points above and below structure sites prior to project implementation. Discharge was measured using a Marsh-McBirney current meter at four macroinvertebrate sampling sites in April and July and was estimated in October.

To further monitor pool depth we established cross sectional transects at 18 structure sites in section one. A minimum of two transects, marked with wooden stakes on each bank,

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[1]Use of trade names does not imply endorsement by the U.S.D.A. Forest Service.

were set up at each site (not necessarily each pool). Most sites had three or more transects, one placed at the head of the site, a minimum of one transect in the middle of the site, and one transect at the tail end of the site. Depth was measured across each transect at 1/4, 1/2 and 3/4 wetted width intervals. Maximum depth was recorded along each transect, even if the maximum depth was not at one of the set measuring intervals; we also recorded the maximum site depth whether it was along a transect or not. Measurements were taken before and after project implementation so we could compare pre and post mean and maximum site depths.

We conducted structure evaluation surveys on 0.2 mi of Fivemile Creek and 0.8 mi of Middle Fork Fivemile Creek to determine maintenance needs and if individual structures were meeting project objectives. As part of the survey we noted structure type, location, position in the channel, performance/condition, and repairs/maintenance needed.

Habitat Improvement Project Implementation

Ramsey Creek

The 1992 Ramsey Creek project goal was to increase rearing habitat quantity and quality for age 1+ and older winter steelhead by adding instream structure within a 2.1 mi stream reach. Specific objectives were:

1. Increase the amount of large woody debris within the project reach.
2. Increase the amount of total fish cover in the project reach.
3. Increase the amount of pool habitat in the project reach.
4. Increase the amount of spawning gravel in the project reach.
5. Trap fine sediment behind log structures.

The two mile project reach was divided into two segments with different treatment methods applied. A walking excavator (spyder), equipped with an opposable thumb on its bucket and a hydraulic winch, built habitat improvement structures in section one. A professional tree faller felled trees into the channel in section two.

We obtained logs for section one using a self loading log truck that picked up roadside blowdown trees located within the Barlow Ranger District. The logs, and about ten root wads, were decked on a ridge top just south of Ramsey Creek near the forest boundary. To minimize resource damage the logs were flown in by a helicopter directed by USFS personnel on the ground. We bucked the logs to the desired length prior to moving them into the drainage.

The spyder built instream log and/or boulder structures directed by district fisheries personnel. Sites selected for treatment were generally shallow pools or glides that lacked depth and/or cover; many sites were located within logging corridors. The spyder excavated below the gradient break, at the head of the pool or glide, and deposited the fill on the downstream riffle. In this manner the gradient of the site was maintained and the existing pool/riffle sequence was essentially unaltered. We did not place logs or boulders as upstream hydraulic controls at every site, only where bank conditions warranted placement. Most logs and boulders placed as upstream controls were in the form of diagonal sills or berms, respectively. Structure height was very low, so as to not back up water and flood the riffle upstream from the excavated pool. Generally, logs were keyed into the bank and cobble fill was placed along the upstream side to seal the structures. We added extra logs and sometimes boulders in pools as cover. Many logs were further anchored by cabling to boulders or trees.

In section two, which was relatively remote, we chose falling existing live trees into the creek instead of using a excavator to reduce riparian damage. Trees for falling were pre selected by USFS personnel and were designed to increase the amount of LWD within the channel in logged corridors. Care was taken to not diminish the potential for long term LWD input or shade providing canopy. A professional faller felled and bucked the marked trees under direction from the district fisheries biologist.

South Fork and Middle Fork Fivemile Creeks

Using Knutsen-Vandenberg (KV) funds from timber sales within the area, habitat improvement projects were implemented within 0.5 mi and 2.0 mi reaches of South Fork Fivemile and Middle Fork Fivemile Creeks, respectively. A spyder excavator built habitat structures in South Fork Fivemile Creek using methods and ideas described above for Ramsey Creek. Youth Conservation Corps and Alternative Labor crews built instream structures in Middle Fork Fivemile Creek, targeting logged corridors that lacked woody debris and habitat diversity.

Eightmile Crossing Campground Rehabilitation and Road Obliteration

The Barlow Ranger District received appropriated Salmon Summit money to accomplish two broad goals during 1992: 1) obliterate roads identified as contributing sediment to anadromous fish bearing streams, and 2) rehabilitate and/or relocate campgrounds located on anadromous fish bearing streams where riparian or stream degradation had occurred. Through previous planning efforts fisheries, watershed, recreation, and road maintenance personnel had identified roads and several campgrounds meeting the above criteria.

We chose Eightmile Crossing Campground as a site for rehabilitation work. Our goal was to promote increased riparian vegetation growth and reduce surface erosion into Eightmile Creek. Specific objectives were:

1. Place boulders and logs to limit parking to designated areas and alter foot traffic in heavily used areas.
2. Break up compacted soils to promote riparian re vegetation.
3. Relocate fire pits and picnic tables away from Eightmile Creek.
4. Plant native vegetation (ground cover and conifers) to speed the recovery process.

We used a small track mounted excavator to place boulders, brought via dump truck from an area three miles away, and logs. The excavator broke up and loosened compacted soil within the campground using its bucket. Fire pits and picnic tables were relocated as far from the creek as possible while still keeping them within the campsite and allowing for adequate shade and seclusion. Native vegetation was planted by hand during the fall 1992.

Road obliteration projects were located in Eightmile and Ramsey Creek drainages. Forest road 4440-180 was identified as a sediment source to Rail Hollow, a small intermittent stream that empties into Eightmile Creek. This road was a valley bottom road, paralleling Rail Hollow for 4.0 miles. The goal for this road project was to reduce sediment input into Rail Hollow. Project objectives were to:

1. Remove 30 culverts.
2. Pull back the side cast into the fill slopes.
3. Reshape the slope to a natural condition.
4. Prevent vehicle access.
5. Plant the area with grass seed.

We used a track mounted excavator to remove the culverts and reshape the road. Other, smaller road obliteration projects were accomplished throughout the two drainages by subsoiling. Goals were to reduce erosion and promote native vegetation growth.

RESULTS AND DISCUSSION

Spawning Surveys - Task 1.1

USFS personnel conducted spawning surveys totaling 8.3, 4.5, 3.5, 0.2, and 0.8 miles on Fifteenmile, Eightmile, Ramsey, Fivemile, and Middle Fork Fivemile Creeks, respectively during the spring of 1992. We counted a total of 20 steelhead redds and saw three live adult steelhead (Table 1). All but one of the redds and the adult steelhead were observed in Fifteenmile Creek; seven redds and one steelhead were within the Mt. Hood National Forest. Six possible redds in Fifteenmile Creek (three each above and below the forest boundary) were not included in the counts as observers were uncertain whether they were single digs or 1991 redds. One redd was counted in Eightmile Creek approximately 0.5 mi upstream from the forest boundary. The lower 4.5 mi (RM 44.4 - 39.9) surveyed on Fifteenmile Creek was below the USFS boundary.

Table 1. Spawning survey dates, river miles, number of steelhead redds, redds per mile, and number of live adult steelhead for five streams in the Fifteenmile Creek Basin. The Mt. Hood National Forest boundary is at RM 44.4 in Fifteenmile Creek, all other streams were surveyed within the Mt. Hood National Forest.

Stream	Date	Reach (RM)	Redds	Redds/mi	Steelhead
Fifteenmile	05/05/92	48.2 - 46.4	3	1.9	1
Fifteenmile	05/04/92	46.4 - 44.4	3	1.5	
Fifteenmile	05/05/92	44.4 - 43.0	3	2.1	1
Fifteenmile	05/04/92	43.0 - 41.0	5	2.5	1
Fifteenmile	05/05/92	41.0 - 39.9	5	4.5	
Eightmile	05/05/92	29.0 - 24.5	1	0.2	
Ramsey	05/06/92	11.0 - 7.5			
Fivemile	04/14/92	18.4 - 18.2			
MF Fivemile	04/14/92	0.8 - 0.0			

The number of redds counted in the basin and within the Mt. Hood National Forest since 1985 has varied (Figure 4). Basin-wide counts were greatest in 1986 and 1987, but have fallen sharply since then. Most spawning has taken place below the forest boundary. There may not be enough returning adults to fully utilize the available spawning habitat below the forest boundary, hence the low number of redds on forest. Total number of redds above the forest boundary has not fluctuated as much as the number of redds found below the forest boundary since 1985; most on forest spawning has occurred in Fifteenmile Creek.

The variable number of redds between years may be due to several factors, including differences in survey scope and timing and in run strength. For example, Fifteenmile Creek was not surveyed above the forest boundary in 1990, and Fivemile and Middle Fork Fivemile Creeks were surveyed in 1992 for the first time since 1986. ODFW did not survey in the basin during 1989 or 1992 nor in Eightmile Creek in 1991 (see Appendix A). Stream reach lengths have also varied between years, particularly those reaches surveyed by USFS personnel. ODFW has established reaches that are surveyed on a regular basis except as

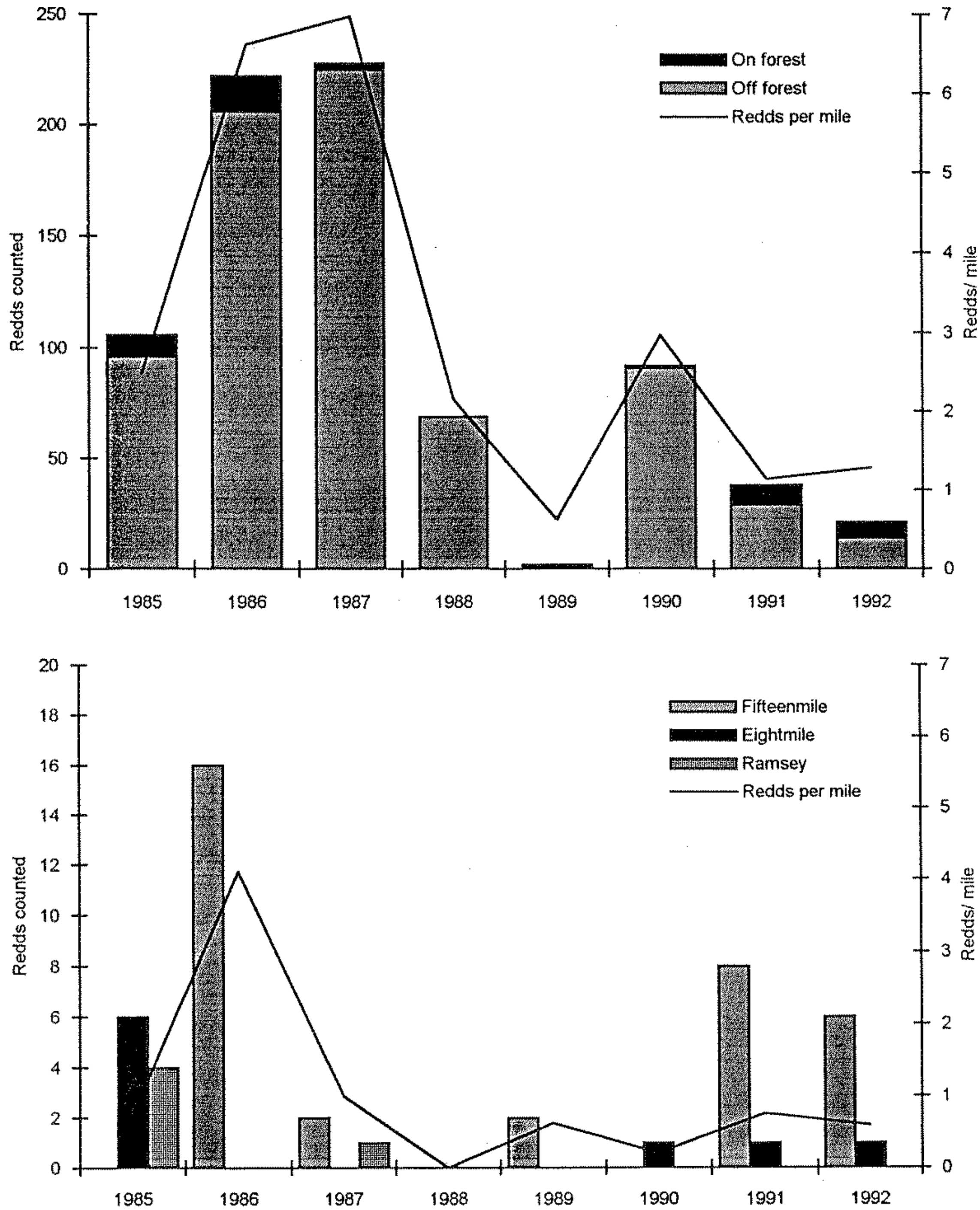

Figure 4. Number of steelhead trout redds and redds per mile in the Fifteenmile Creek Basin (top graph) and upstream from the Mt. Hood National Forest boundary (bottom graph) from 1985 to 1992. ODFW did not survey in the basin during 1989 and 1992, nor in Eightmile Creek in 1991. USFS did not survey Fifteenmile Creek above the forest boundary in 1990. Miles surveyed varied between years (see Appendix A).

noted; standard reaches in each creek on forest have been established by the USFS for future surveys.

The 16 redds counted in 1986 above the forest boundary seems inconsistent compared to other years. All redds counted within the Mt. Hood National Forest in 1986 were within a 1.4 mi reach in Fifteenmile Creek, which accounts for the redds/mi figure more than double any other year since 1985 (Figure 4, bottom graph). Steelhead run sizes were considerably higher in 1986 and 1987 compared to other years since 1985, and that may explain the high redd count on forest in 1986. However, the number of redds on forest in 1987 was much lower, even though the total run size was greater that year. It may be that surveyors counted individual digs as redds thereby artificially inflating the redd count.

Macroinvertebrate Monitoring - Task 1.2

Forty five macroinvertebrate samples were collected during April, July, and November 1992 in Ramsey, Fivemile, Eightmile, and Fifteenmile Creeks. The 1991 and 1992 annual reports from the USFS Region 4 macroinvertebrate analysis lab are currently in preparation.

Macroinvertebrates respond to changes in aquatic habitat, and analysis of macroinvertebrate community structure can reveal condition and trends in aquatic ecosystems (Mangum 1987). Macroinvertebrate diversity indices are a measure of stress in the environment and assume that large numbers of species are present in an unpolluted, or unstressed, environment (Mason 1981). One of the indices used by Mangum (1987) is the Dominance and Taxa (DAT) diversity index, which combines a measure of dominance of species in the community and the number of species present. DAT diversity index values between 11 and 17 indicate good environmental conditions while values greater than 18 indicate excellent conditions. From 1986 through 1990 none of the DAT diversity index values from sites within the Mt. Hood National Forest were below those considered good, and most were in the excellent range (Figure 5). There was year to year and seasonal variation, but given the variable nature of aquatic ecosystems this was not unexpected.

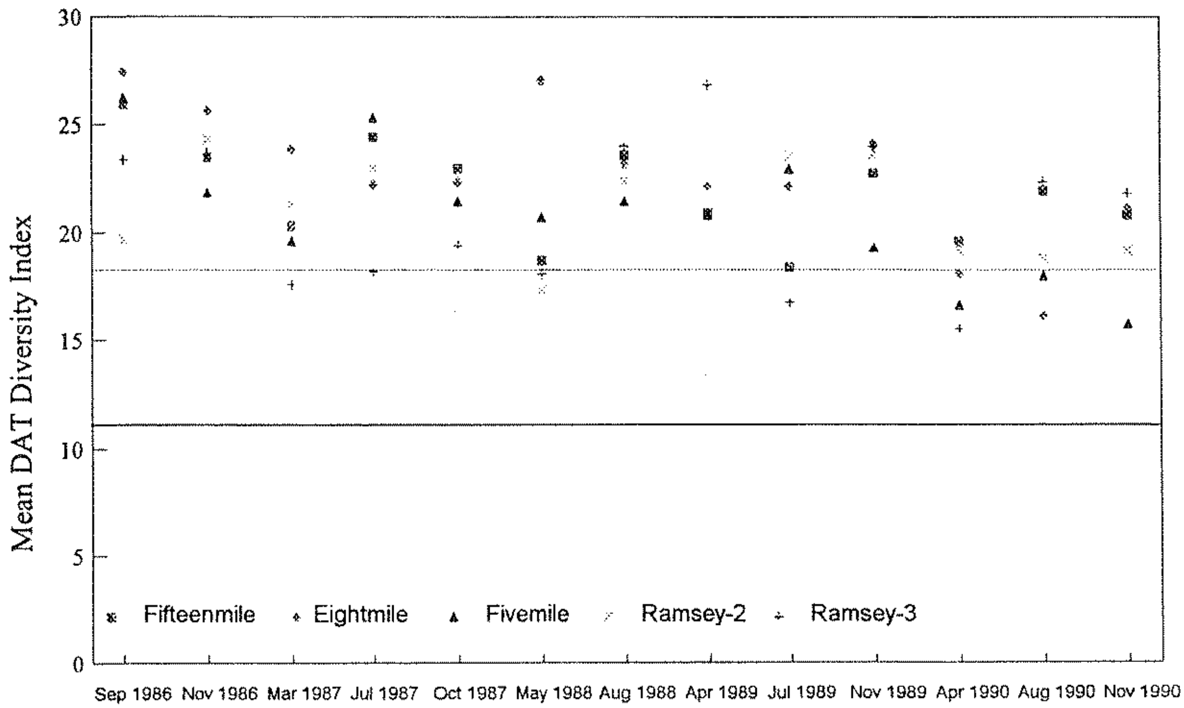

Figure 5. Dominance and taxa (DAT) diversity index values for macroinvertebrates collected from five sites within the Fifteenmile Creek Basin during 1986 - 1990. Each point represents the mean from three samples taken at each site. Values above the dashed horizontal line indicate excellent environmental conditions, values between the solid and dashed lines indicate good environmental conditions.

Water Temperature Monitoring - Task 1.4

Water temperatures in the Fifteenmile Creek Basin in the Mt. Hood National Forest during 1992 were similar to previous years that data has been gathered (see Asbridge 1990 and Asbridge and Brun 1991). Maximum water temperatures of 20.0, 16.5, and 17.0 ^{o}C were recorded during late June in Fifteenmile, Ramsey, and Eightmile Creeks, respectively, at forest boundary sites (Figures 6, 7, and 8). A maximum water temperature of 18.5 ^{o}C was recorded in late July in Fivemile Creek at the forest boundary (Figure 9). There were three temperature peaks during 1992: one in late June, one in late July and another in mid August.

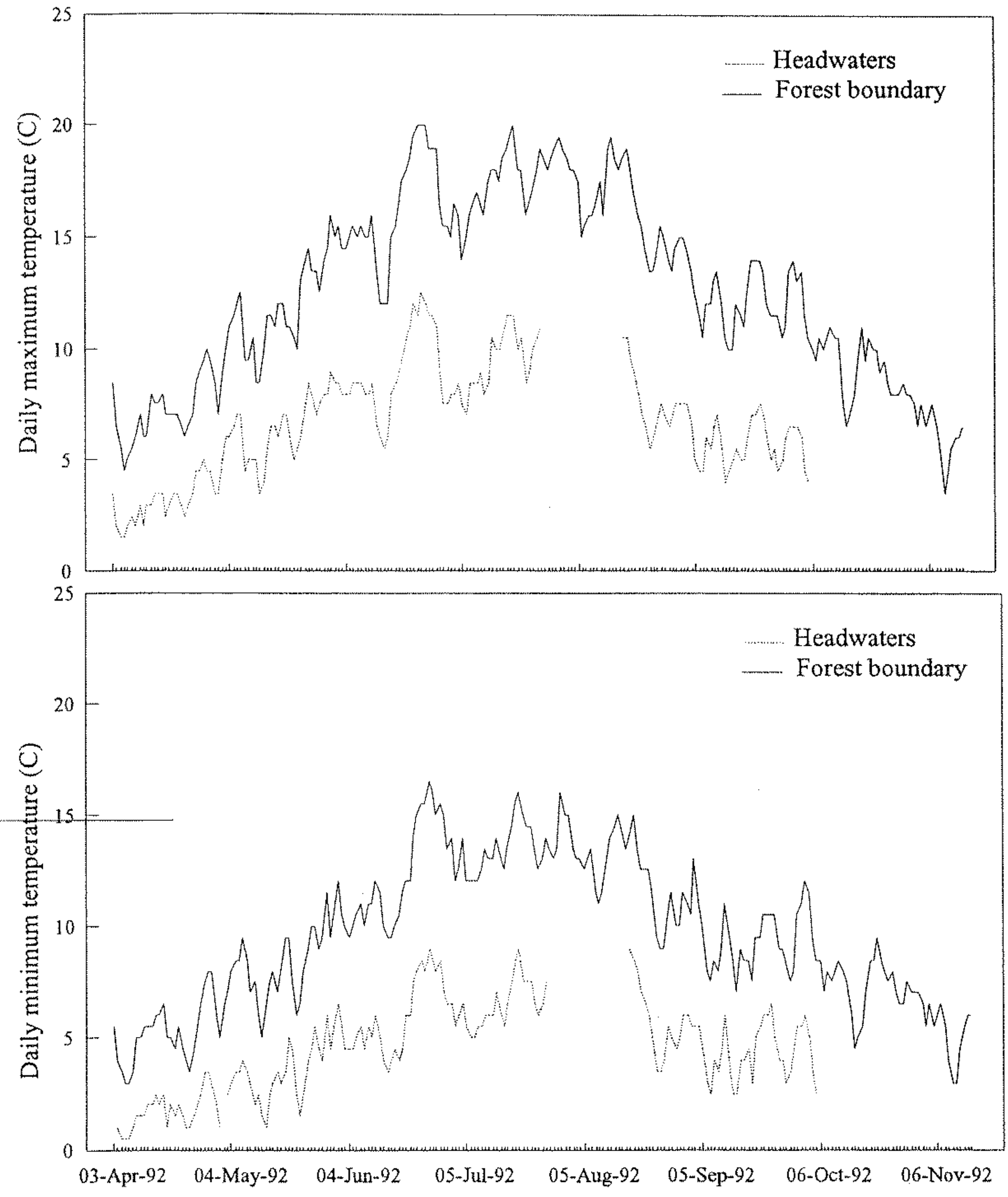

Figure 6. Daily maximum (top graph) and minimum (bottom graph) water temperatures (^{O}C) recorded near the Forest boundary (RM 43.4) and headwaters (RM 51.7) in Fifteenmile Creek from 3 April to 15 November 1992. The headwater thermograph was removed from 27 July to 16 August and again on 5 October for the remainder of the season.

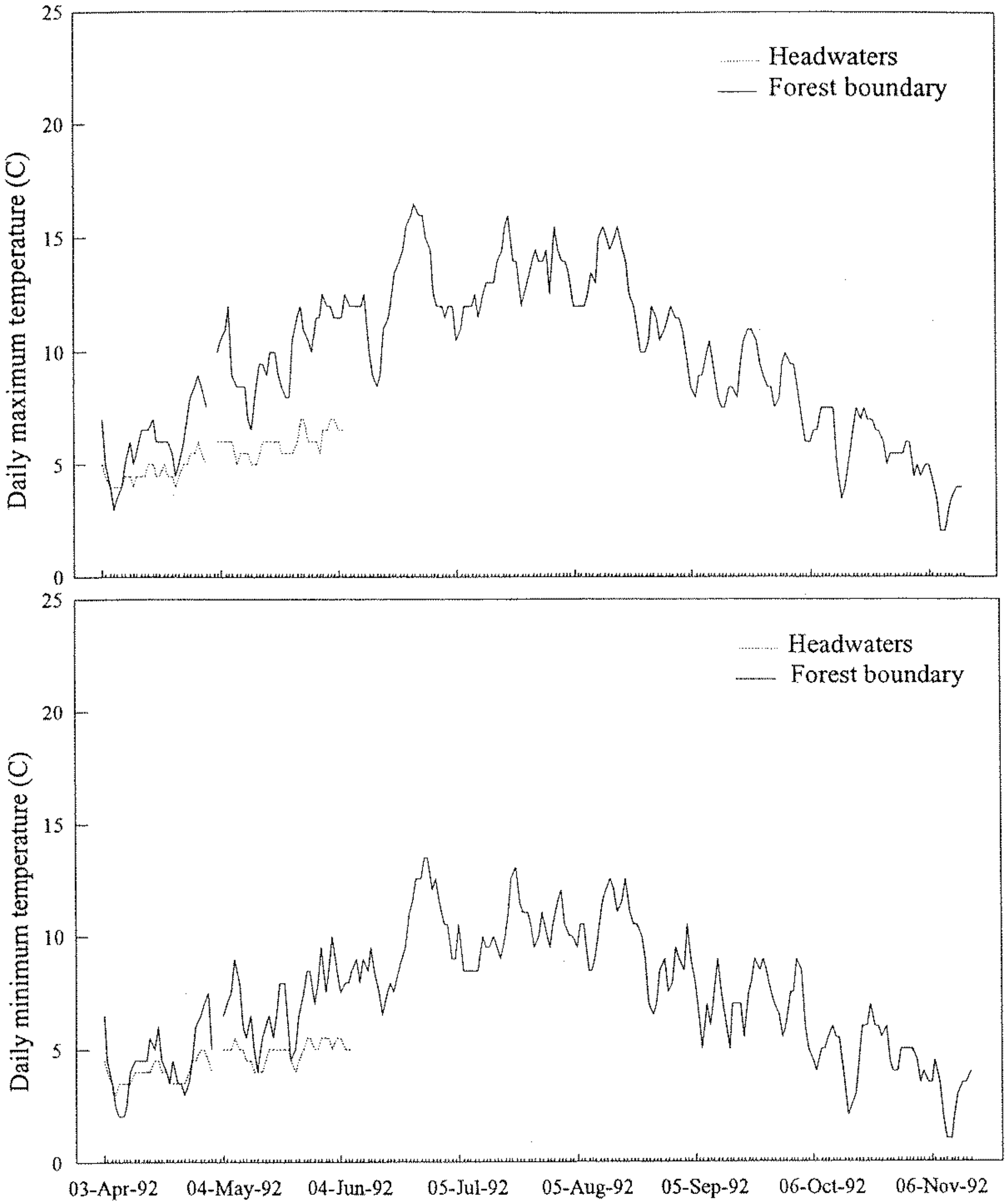

Figure 7. Daily maximum (top) and minimum (bottom) water temperatures (^{O}C) recorded near the Forest boundary (RM 8.4) and headwaters (RM 16.4) in Ramsey Creek from 3 April to 15 November 1992. The headwater thermograph was removed 6 June 1992.

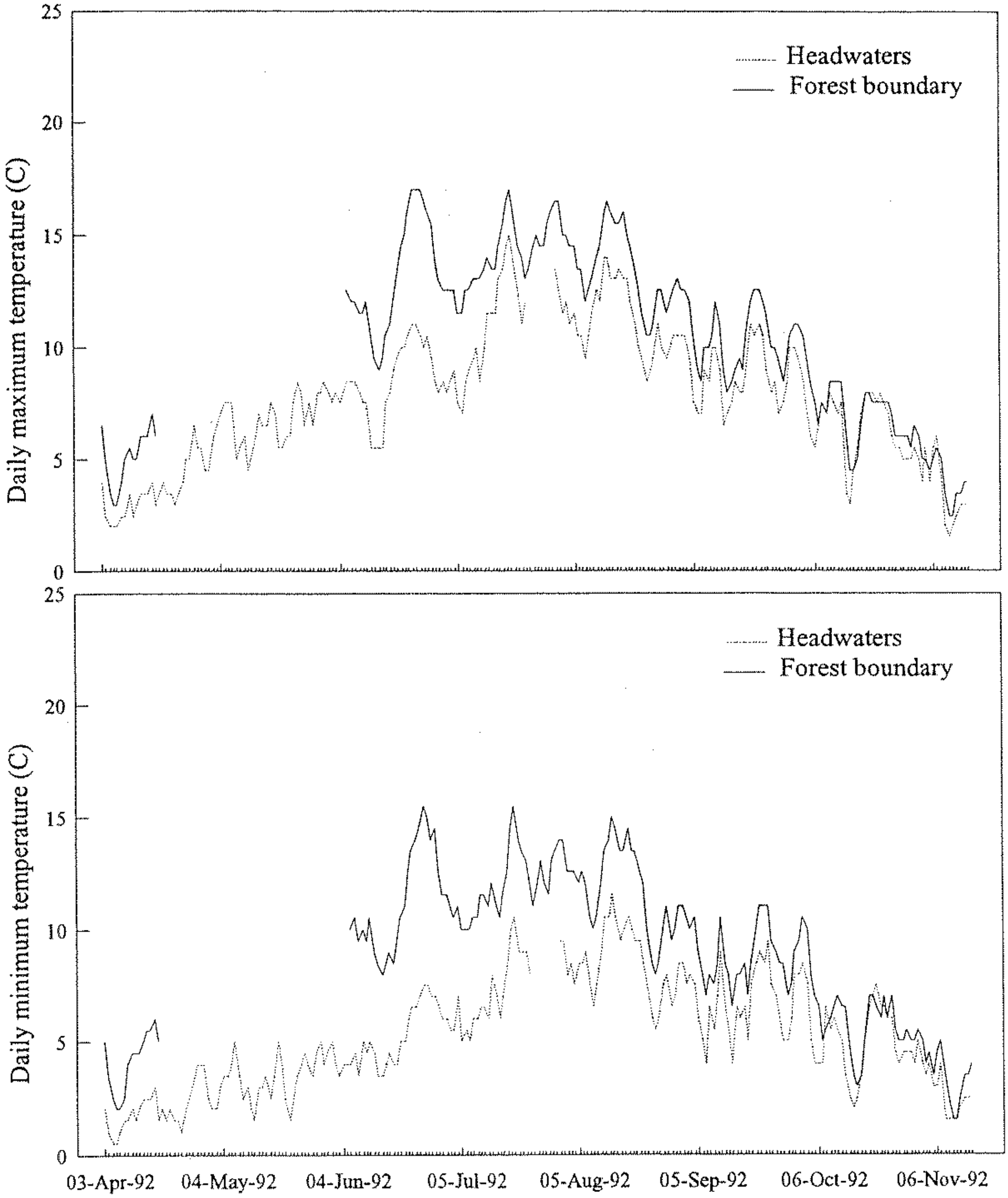

Figure 8. Daily maximum (top) and minimum (bottom) water temperatures (^{o}C) recorded at the Forest boundary (RM 24.5) and headwaters (RM 32.4) in Eightmile Creek from 3 April to 15 November 1992. The Forest boundary thermograph was removed from 18 April to 5 June.

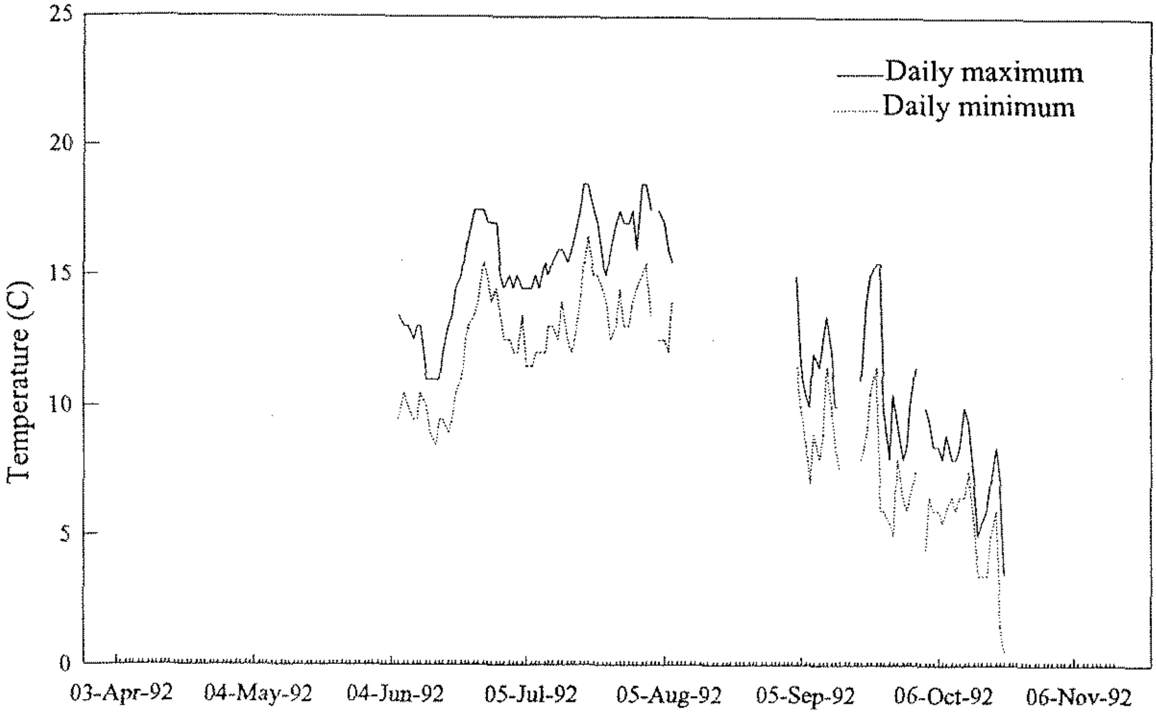

Figure 9. Daily maximum and minimum water temperatures (^{O}C) recorded near the Forest boundary (RM 18.3) in Fivemile Creek from 3 April to 15 November 1992. Temperatures were not recorded from 3 April to 5 June, 3 August, 8 August to 3 September, 15 September to 18 September, 2 October, and 22 October to 15 November due to thermograph malfunction or the probe being out of the water.

In previous years maximum temperatures did not occur until late July or August (Asbridge 1990; Asbridge and Brun 1991). The early peak this year was likely a result of drought conditions and hot, dry weather in May and June. Daily minimum temperatures were similar to daily maximum temperatures during spring and fall, but the differences increased in summer and ranged from 2 to 5 ^{O}C. Temperature regimes were similar for the four creeks.

Stream temperatures at the USFS boundary regularly exceeded the Oregon State Standard of 14.4 ^{O}C (58 ^{O}F) and approached the targeted maximum temperature of 21^{O}C for the mouth of Fifteenmile Creek (Smith et al. 1987). Fifteenmile Basin streams on USFS land are generally well shaded, even in timber harvest areas. The chances are low that the USFS, through land management practices, can significantly lower summer maximum stream temperatures within the National Forest. Even if ODFW is successful in establishing a continuous riparian buffer zone along Fifteenmile Basin streams below the USFS boundary, maximum stream temperatures at the mouth may still exceed the 21 ^{O}C target. Contributing causes include the usual hot, dry summers in the area and the amount of water diverted or pumped out for irrigation.

Although maximum water temperatures in the Fifteenmile Creek Basin above the Mt. Hood National Forest boundary are below temperatures considered lethal to salmonid fishes (Lee and Rinne 1980; Bell 1986), temperatures do reach levels that may influence fish movement, feeding behavior and growth rates. Temperatures preferred by rainbow or steelhead trout will depend, in part, on the natural range found in the streams they live in. Native trout which live in relatively warmer streams are likely acclimated to increased temperatures encountered therein. Preferred temperatures for rainbow and steelhead trout cited in the literature are varied and may reflect natural variability and/or experimental design, but range from 10 to 20 ^{O}C (Coutant 1977; Bell 1986; Baltz et al. 1987). During periods of high temperatures salmonids in the Fifteenmile Creek Basin may move upstream, into tributaries, or even seek refuge in deeper pools with cooler water.

Feeding behavior and growth rates also vary with temperature. Smith and Li (1983) found that juvenile steelhead moved to areas with higher water velocities when water temperatures increased. Metabolism and digestion rate increase with increasing temperatures; juvenile steelhead moved to faster water to take advantage of increased invertebrate drift even though metabolic costs were also higher in terms of swimming. Steelhead in the Fifteenmile Creek Basin likely follow this pattern and seek faster water to feed as temperatures increase. Growth rates also tend to increase with increasing temperature (if abundant food is available), up to a point, and then decline (Brett et al. 1969; Elliot 1975; Hokanson et al. 1977). Hokanson et al. found growth rates of juvenile rainbow trout were greatest at temperatures from 15.5 to 17.3 ^{O}C, when diel temperatures fluctuated about 4 ^{O}C about the mean, and declined after that. Mean water temperatures in the

Fifteenmile Basin on Mt. Hood National Forest lands rarely get above 18 ^{O}C. Given that food abundance is adequate, growth rates may be good on forest. However, other factors such as rearing space and fish densities may offset this.

Physical and Biological Monitoring - <u>Tasks 2.1 and 4.2</u>

The 1992 Ramsey Creek project area was surveyed before habitat enhancement work was initiated and the report is in preparation. Post project surveys are scheduled for summer 1993 in Fifteenmile Creek project reaches (projects implemented in 1989 and 1990), Fivemile and Middle Fork Fivemile Creek project reaches (1991), and the Ramsey Creek project reach (1992). Pre and post project results for previous projects in Ramsey Creek and pre-project results for Fifteenmile Creek (RM 44.4-45.4 and 45.4-47.4), Middle Fork Fivemile Creek, and Fivemile Creek are presented in separate USFS Monitoring and Evaluation reports (Grimes 1987 and 1988; Sheldon and Shively 1989; Byers and Lindland, in preparation; Bergamini et al., in preparation).

Discharge varied between streams with Fifteenmile Creek having the highest flow and Fivemile Creek the lowest for days measured in 1992 (Table 2). Flows in the Fivemile Creek drainage appear to fluctuate more than in other drainages within the basin. South Fork Fivemile Creek becomes an intermittent stream during late summer/early fall, at least for the last several years. We are uncertain as to why this drainage has a flashier flow regime, but timber harvest and road densities likely influence this pattern.

Mean site depth in section one was greater after project implementation based on measurements taken across transects in 18 sites (Table 3). The mean depth increase for all the sites was 4.78 inches (S.D. = 2.09, range = 0.69 to 8.29). Mean maximum depth increases for nine of the sites was 17.2 inches (S.D. = 7.5, range = 4 to 25.5). Post-project measurements were taken after a rainstorm and water levels appeared one or two inches higher than when pre-project measurements were taken. In sites 17 and 22 the mean site depth increase was less than two inches and may be due to higher water levels, not from the habitat improvements. In the future, we will measure discharge when measuring transects to correlate depth increases/decreases with flow.

Table 2. Discharge, in cubic feet per second, measured at six locations in the Fifteenmile Creek Basin during 1992. Discharge values in ***italics*** were estimated, not measured. The Fifteenmile Creek site was one mile below the Mt. Hood National Forest boundary.

Stream	River mile	Date	Discharge
Fifteenmile Cr.	43.4	April 2	9.1
		July 14	6.3
		October 6	***5.0***
Eightmile Cr.	29.0	May 2	4.5
		July 14	2.0
		October 7	***1.0***
Ramsey Cr.	8.3	April 2	3.7
		July 14	1.6
		October 7	***0.85***
Fivemile Cr.	18.3	February 27	36.6
		April 2	3.6
		July 7	0.16
		October 7	***very low***
Middle Fork Fivemile Cr.	0.05	February 27	14.9
South Fork Fivemile Cr.	0.05	February 27	14.7

Table 3. Mean wetted widths, mean water depths and maximum water depths along transects within habitat improvement sites in Ramsey Creek. Pre-project measurements were taken in October 1992, post-project measurements (**bold**) were taken during October and November 1992. For sites 19 - 26 wetted widths and maximum depths were not recorded prior to project implementation.

Site	Number of transects	Mean wetted width (ft)	Mean site depth (in)	Maximum transect depth (in)
3 (Pre)	3	10.11	3.75	8.0
3 (Post)	**3**	**10.25**	**10.58**	**33.0**
4 (Pre)	3	6.97	3.66	8.5
4 (Post)	**3**	**9.58**	**10.83**	**34.0**
5 (Pre)	3	9.5	6.79	18.0
5 (Post)	**3**	**11.27**	**10.96**	**26.0**
6 (Pre)	3	10.8	6.46	13.0
6 (Post)	**3**	**9.0**	**10.58**	**33.0**
7 (Pre)	4	8.95	4.9	12.0

Table 3 (continued)

Site	Number of transects	Mean wetted width (ft)	Mean site depth (in)	Maximum transect depth (in)
7 (Post)	**4**	**8.5**	**10.87**	**33.0**
8 (Pre)	3	6.75	4.96	9.0
8 (Post)	**3**	**7.9**	**13.25**	**27.0**
11 (Pre)	3	10.66	8.04	20.0
11 (Post)	**3**	**10.22**	**15.66**	**32.0**
12 (Pre)	3	11.83	5.21	20.0
12 (Post)	**3**	**12.69**	**9.08**	**24.0**
13 (Pre)	3	10.05	4.08	10.0
13 (Post)	**3**	**10.22**	**8.70**	**31.0**
15 (Pre)	5	11.56	5.07	
15 (Post)	**5**	**12.01**	**7.68**	**26.0**
17 (Pre)	3	11.77	3.71	
17 (Post)	**3**	**11.66**	**5.04**	**29.0**
19 (Pre)	3		3.16	
19 (Post)	**3**	**8.38**	**8.08**	**22.0**
20 (Pre)	2		4.75	
20 (Post)	**2**	**8.25**	**11.87**	**19.0**
22 (Pre)	2		4.31	
22 (Post)	**2**	**10.0**	**5.00**	**12.0**
23 (Pre)	5		6.35	
23 (Post)	**5**	**11.16**	**10.77**	**29.0**
24 (Pre)	5		4.3	
24 (Post)	**5**	**12.5**	**8.5**	**27.0**
25 (Pre)	2		6.25	
25 (Post)	**2**	**15.25**	**9.6**	**28.0**
26 (Pre)	4		3.65	
26 (Post)	**4**	**9.62**	**8.37**	**25.0**

Habitat Improvement Structure Maintenance - <u>Task 3.1</u>

In Fivemile and Middle Fork Fivemile Creeks we found the majority of structures built in 1991 to be intact and meeting their intended objectives (Table 4). Few of the structures had shifted and only four, all in Middle Fork Fivemile Creek, had left the project site. All but two of the structures in Fivemile Creek needed some type of maintenance, mostly adding cobble fill upstream of the structure to seal it or armoring the bank where water flowed around the structure. Little maintenance was needed in the Middle Fork Fivemile Creek reach.

Table 4. Number of structures installed during 1991 meeting different performance criteria and needing some type of maintenance in Fivemile and Middle Fork Fivemile Creek project reaches.

	Performance								Maintenance
Stream	1a	1b	1c	2a	2b	2c	3b	3c	needed
Fivemile	19	3		1		1			21 (91%)
M.F. Fivemile	40	8	4	6	5	2	1	3	19 (28%)
Total	**59**	**11**	**4**	**7**	**5**	**3**	**1**	**3**	**40 (43%)**

Key: 1 = Structure in place. a = Fully meeting objective.
2 = Shift on site. b = Partially meeting objective.
3 = Left project site. c = Not meeting objective.

We repaired the 21 structures in Fivemile Creek, and three in Middle Fork Fivemile Creek, in June 1992 using a hand labor crew. Each structure had additional gravel or cobble fill placed on the upstream side to seal it and force the water over the logs. We also added additional boulders and fill where the structures were keyed into the banks. These maintenance measures will increase the longevity and performance of the structures. Structure evaluation surveys will be conducted at regular intervals to further monitor trends and identify maintenance needs.

The difference in maintenance needs between the two reaches lay in the construction method. Structures in Fivemile Creek were placed using hand labor, those in Middle Fork Fivemile Creek were constructed using a spyder excavator. When designing a habitat improvement project using instream structures, one must carefully consider project objectives before using a labor crew or a excavator. If protecting the riparian area is a primary objective then installing structures by hand may be the preferred method; however, there may be an increased cost in future maintenance and the structures may not last as long. Based on these results, and from other structure evaluation surveys from creeks within the Barlow Ranger District, we feel hand labor is warranted for projects not involving "heavy" construction, such as woody debris loading, fish cover addition, or bank revetment. In those projects where increases in pool habitat and large wood additions are desired a track mounted or spyder excavator may be the preferred method.

Ramsey Creek Habitat Improvement - Task 4.4

Section one

The spyder, working at 26 sites, built 40 log and/or boulder structures. Fifty two logs and nine root wads, flown in by the helicopter, were used in addition to ten logs from on site. Boulders were used from within the project reach. Each structure was built under the direct supervision of district fisheries personnel. The types of structures installed were varied and included diagonal log sills, upstream V's, deflector logs, and boulder berms. However, at many sites we excavated pools and did not install an upstream hydraulic control if the riffle and stream banks directly upstream appeared stable. This type of design differs from previous habitat improvement work implemented in the Barlow Ranger District. We plan extensive monitoring to determine if these designs work and whether they may be applicable in other systems.

A primary objective of the project was to increase available cover for all salmonid life stages. The majority of the logs used in the project were added as cover logs, not hydraulic controls. A minimum of two logs per site were added as cover. Smaller woody material (< 6 inches in diameter) left over from previous logging activity was also added when possible.

Section two

The faller felled 60 trees into the channel within this 1.3 mi reach, primarily into existing logging corridors from adjacent stands. A variety of species were dropped including douglas fir, grand fir, engelmann spruce, and western red cedar. Most trees were growing in the flood plain on the north side of Ramsey Creek, although many were located on upslope areas. Trees were felled only if the number of trees in the area was enough to ensure long term woody debris input to the channel and riparian area, and shade providing canopy was not reduced. In short, if the short term benefits to the stream and channel did not outweigh the long term benefits, we did not fall the tree.

Trees were felled to meet a variety of objectives, depending on the location. At many sites fallen trees were designed to provide fish cover only; whereas at other sites we hoped the tree(s) would act as a hydraulic control and form a pool or deepen an existing pool. Creating more pool habitat from this type of project takes longer than using an excavator because natural processes do most of the work as opposed to artificial processes. Even if there are several years with normal to high flow events there may not be a significant difference in habitat composition. Benefits are immediate in terms of cover addition however. In areas with limited access or very sensitive riparian areas this kind of project may be warranted as opposed to using heavy equipment. If the riparian stands are in need of thinning or some other type of silvicultural treatment this project method can be used to meet both fisheries and silvicultural objectives.

South Fork Fivemile Creek Habitat Improvement

The spyder built 29 fish habitat structures in a 0.5 mile reach (RM 0.0 - 0.5). Structure design was similar to that described for section one in Ramsey Creek. South Fork Fivemile Creek is an intermittent stream and was not flowing when this project was implemented. Planning and design of this project occurred when there was water in the channel. This project was mitigation for the South Five Timber Sale, logged during the late 1980's, and was funded with KV funds.

Middle Fork Fivemile Creek Habitat Improvement

Youth Conservation and alternative labor work crews built 37 fish habitat improvement structures within a two mile reach. The project, funded with KV funds, was mitigation for the Reknebal Timber Sale. The area was logged during the early 1980's.

Log sills, boulder berms and upstream V structures were created using materials from the immediate area. Logs, slash, tree tops, and boulders were used as fish cover; some type of cover was added at every site.

Eightmile Creek Interpretive Trail

BPA dollars were used to design and purchase interpretive signs and mounting materials. Several disciplines were involved in sign design including recreation, fisheries, wildlife, soils/watershed, botany, and silviculture. Completed signs will be installed during spring 1993.

Eightmile Crossing Campground Rehabilitation

Using appropriated Salmon Summit funds, we modified ten campsites in a two day period by placing boulders and logs, relocating fire pits and picnic tables, and breaking up compacted soil. Two of the campsites were completely obliterated and then relocated across the road, away from the creek. New parking stops were installed at three campsites. Native tree seedlings and ground cover from the surrounding area were planted in the campground during late fall.

During the short time period between project completion and the first snow fall it appeared altering foot traffic and limiting parking objectives were met. The campground received relatively heavy use during this time period as it was deer and elk hunting season. One of the logs placed as a barrier was cut up and removed, presumably for firewood, in a matter of days. We recommend using boulders for this type of project to avoid this problem. We relied heavily upon Barlow Ranger District recreation personnel while planning and implementing this project. Any habitat improvement project undertaken in a campground or other recreation site should include recreation personnel in the planning and design stages and, ideally, during implementation as well.

Road Obliteration

The four mile long 4440-180 road was completely reshaped along its entire length. Once the berm blocking the road was removed a track mounted excavator pulled all of the culverts which were then hauled off site. The cut slope side of the road was then subsoiled to a depth of three feet; fill was then pulled by the excavator resulting in a natural slope contour. Boulders and logs were placed on the "road" to create a natural landscape and deter vehicle traffic. Several large boulders and shrubs were planted at the entrance to disguise it. Finally, USFS personnel spread seed, fertilizer and straw mulch along the entire length of the site. Unit costs for this project were approximately $5,000 per mile; the project was funded with appropriated Salmon Summit funds.

Eighteen miles of native surface system and non-system roads were obliterated by subsoiling in the Ramsey and Eightmile Creek drainages. Primary benefits from subsoiling include reduced erosion and increased natural re vegetation .

SUMMARY and CONCLUSIONS

Structural improvements in the Ramsey Creek project (section one) were designed differently compared to projects implemented by the authors in previous years. We paid close attention to maintaining the natural gradient and targeted areas that were already pools or glides for enhancement. Few hard structures were installed and the majority of the logs were placed as cover. Based on a cursory examination of the project area during spring 1993, all of the wood was in place and none of the excavated pools had filled in with sediment. We are encouraged by these preliminary results and hope extensive monitoring will prove these fisheries habitat improvements will maintain themselves over time. Although hard structures such as sills, upstream V's, deflectors, etc. are an important tool in fish habitat restoration it is important to recognize appropriate locations for placement based on channel conditions, flow regimes, land management practices, and project objectives. A basic understanding of fluvial geomorphic principles is essential to design and implement a project tailored to the stream and its natural range of variability.

Average cost per structure for the entire Ramsey Creek project was $599.00. We did not include costs incurred for macroinvertebrate and temperature monitoring in this calculation. Costs per structure were more expensive compared with BPA funded work completed in 1991. We spent more time planning and more time at each site during implementation which partly accounts for the increased costs. Use of the helicopter also added to the total cost, but we feel the reduced impacts to the ground were worth it. Costs varied greatly by section as well. In section one the average cost per structure was $1,375.00 as compared to $83.00 per structure in section two. Falling trees into the channel is an inexpensive method to improve fish habitat. However, benefits are not as immediate with this type of project, in terms of creating pool habitat, and the degree of control is not nearly as great.

We have reported on other projects occurring within the basin because we feel it is important to illustrate the full range of activities and projects implemented in the Barlow Ranger District. The USFS is taking an increased holistic view of land management and we feel that is reflected in the breadth of projects described herein. Projects such as road obliteration treat problems at their source as opposed to a band-aid approach so often taken in the past.

Monitoring programs proceeded according to schedule during 1992. We have been collecting macroinvertebrate and temperature data on a regular basis since 1987. Due to budget cutbacks and the fact that we have excellent baseline data we will be cutting back on these programs in the future. We plan to collect macroinvertebrate samples every two to three years and will only install thermographs at the forest boundary in the future. Spawning surveys will continue to be an annual program. Established spawning survey reaches will enable us to better monitor long term trends and compare data between years. Structure evaluations were conducted in the Fivemile Creek drainage in 1992. Our intent is to survey every project reach within the Fifteenmile Creek Basin every two to three years, more frequently if time and money allow. Post project monitoring and evaluation stream surveys are scheduled for 1993 in all project reaches within the basin on forest. It is these surveys that enable us to determine if project objectives are met.

The stated objectives for the Ramsey Creek project should have been tied to numeric values to facilitate measurement and evaluation. Accurate measurement of objectives 3-5 may be difficult. There is a chance we will not meet objective 3, increasing the amount of pool habitat, because we generally worked in existing pools. However, based on pre and post transect measurements we did increase pool depth and low flow pool volume.

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SUMMARY OF EXPENDITURES

A. Personnel	Grade	MD	Rate	Costs
Project Leader	12	12	$179.00	$2,148.00
Project Assistant	11	15	$165.45	2,481.75
Zone Fisheries Biologist	11	40	$165.45	6,618.00
Hydrologist	11	15	$145.44	2,181.60
District Fisheries Biologist	9	55	$150.40	8,272.00
General Biologist	9	55	$110.52	6,078.60
Hydrology Technician	7	5	$113.00	565.00
Biological Technician	5	10	$72.96	729.60
Biological Aid	3	20	$58.16	1,163.20
Monitoring & Evaluation Crew	7	50	$90.40	4,520.00
			Subtotal	$34,757.75

B. Travel		
6,000 miles @ $0.24/mile		$1,440.00
Field per diem - 32 days @ $15.00/day		480.00
Rental vehicle - 6 months @ $500.month		3,000.00
	Subtotal	$4,920.00

C. Expendable materials		
1000 ft 1/4" galvanized cable @ $0.18/ft		$180.00
Miscellaneous (Cable clamps, film, etc.)		400.00
Thermograph computer software		283.20
	Subtotal	$863.20

D. Overhead (12% of A, B, and C)		
	Subtotal	$4864.91

E. Contract Costs		
Spyder Back hoe - $124.75/hr for 74 hrs. (mobilization included)		$9231.50
Tree faller - $45.00/hr for 18 hrs		810.00
Self loading log truck - $55.00/hr for 12hrs		660.00
Helicopter - $450/hr for 7.6 hrs		3,420.00
Helicopter support (ground crew, fuel truck)		1,859.00
	Subtotal	$15,980.50

F. Macroinvertebrate analysis		
15 sites @ $135/site x 3 samples/site/year		$6075.00
	Subtotal	$6075.00

TOTAL FY 1991-1992 Project Costs **$67,461.36**

APPENDIX A

Winter steelhead redd counts in the Fifteenmile Basin, 1964-1992

Fifteenmile Creek

Year	Reach	Distance (mi)	Land ownership	Redds	Redds/mi
1964	Dufur valley	5.0	Private	87	17.4
1966	Dufur valley	5.0	Private	20	4.0
1967	Dufur valley	5.0	Private	32	6.4
1968	Dufur valley	5.0	Private	23	4.6
1970	Dufur valley	5.0	Private	2	0.4
1984	RM 30.4-44.4	14.0	Private	24	1.7
1985	RM 30.4-44.4	14.0	Private	29	2.1
	RM 44.4-49.0	**4.6**	**USFS**	**0**	**0.0**
1986	RM 30.4-44.4	14.0	Private	64	4.6
	RM 44.4-45.8	**1.4**	**USFS**	**16**	**11.4**
1987	RM 30.4-44.4	14.0	Private	76	5.4
	RM 44.4-45.4	**1.0**	**USFS**	**2**	**2.0**
1988	RM 30.4-44.4	14.0	Private	28	2.0
	Not recorded	**0.7**	**USFS**	**0**	**0.0**
1989	**RM 44.4-45.4**	**1.0**	**USFS**	**2**	**2.0**
1990	RM 30.4-39.9	9.5	Private	38	4.0
1991	RM 30.4-44.4	14.0	Private	26	1.9
	RM 44.4-48.2	**3.8**	**USFS**	**8**	**2.1**
1992	RM 39.9-44.4	4.5	Private	14	3.1
	RM 44.4-48.2	**3.8**	**USFS**	**6**	**1.6**

NOTE: ODFW did not survey Fifteenmile Creek in 1989 and 1992 (the private reach was surveyed by USFS personnel). USFS did not survey Fifteenmile Creek on forest in 1990. RM 30.4 is the town of Dufur, RM 44.4 is the forest boundary.

Eightmile Creek

Year	Reach	Distance (mi)	Land ownership	Redds	Redds/mi
1985	RM 10.8-19.0	8.2	Private	64	7.8
	RM 24.5-29.0	**4.5**	**USFS**	**6**	**1.3**
1986	RM 10.8-19.0	8.2	Private	111	13.5
	RM 24.5-26.0	**1.5**	**USFS**	**0**	**0.0**
1987	RM 10.8-19.0	8.2	Private	102	12.4
	RM 23.5-24.5	1.0	Private	0	0.0
1988	RM 10.8-19.0	8.2	Private	18	2.2
	Not recorded	**0.5**	**USFS**	**0**	**0.0**
1989	**RM 24.5-25.5**	**1.0**	**USFS**	**0**	**0.0**

Eightmile Creek (con't)

1990	RM 10.0-19.0	9.0	Private	41	4.5
	RM 24.5-28.5	**4.0**	**USFS**	**1**	**0.25**
1991	**RM 24.5-29.0**	**4.5**	**USFS**	**1**	**0.2**
1992	**RM 24.5-29.0**	**4.5**	**USFS**	**1**	**0.2**

NOTE: USFS did not survey Eightmile Creek on forest in 1987. ODFW did not survey Eightmile Creek in 1989, 1991 and 1992. RM 24.5 is the forest boundary.

Ramsey Creek

Year	Reach	Distance (mi)	Land ownership	Redds	Redds/mi
1985	RM 0.0-7.5	7.5	Private	3	17.4
	RM 7.5-11.4	**3.9**	**USFS**	**4**	**4.0**
1986	RM 0.0-7.5	7.5	Private	31	6.4
	RM 7.5-8.5	**1.0**	**USFS**	**0**	**4.6**
1987	RM 0.0-7.5	7.5	Private	47	6.3
	RM 7.5-8.5	**1.0**	**USFS**	**1**	**1.0**
1988	RM 0.0-7.5	7.5	Private	23	3.1
	RM 7.5-8.5	**1.0**	**USFS**	**0**	**0.0**
1989	**RM 7.5-8.7**	**1.2**	**USFS**	**0**	**0.0**
1990	RM 0.0-7.5	7.5	Private	12	1.6
	RM 7.5-8.5	**1.0**	**USFS**	**0**	**0.0**
1991	RM 0.0-7.5	7.5	Private	3	0.4
	RM 7.5-11.0	**3.5**	**USFS**	**0**	**0.0**
1992	**RM 7.5-11.0**	**3.5**	**USFS**	**0**	**0.0**

NOTE: ODFW did not survey Ramsey Creek in 1989 and 1992. RM 7.5 is the forest boundary.

Fivemile Creek

Various reaches of Fivemile Creek and Middle Fork Fivemile Creek on forest were surveyed in 1985, 1986 and 1992. No steelhead redds were seen. To our knowledge, ODFW has never conducted a spawning survey in Fivemile Creek.

APPENDIX B

Monthly maximum, minimum, and mean water temperatures in the Fifteenmile Basin within the Mt. Hood National Forest: 1989 - 1992. Missing data for each stream results from a variety of reasons including thermograph malfunction, temperature probe out of the water resulting in inaccurate recordings, and thermographs not installed due to lack of access (snow).

Fifteenmile Creek (Headwaters and **Forest boundary** sites)

	May	June	July	August	September	October
Maximum						
1989		7.0	10.0	10.0	9.5	9.0
1990		8.5	10.5	11.5	9.0	7.5
1991			10.0	10.5	8.5	7.5
1992	9.0	12.5	11.5		7.5	
1989	**9.0**	**11.5**	**15.0**	**16.0**	**12.0**	**9.5**
1990	**9.0**	**14.5**	**17.5**	**18.5**	**15.0**	**12.0**
1991		**12.0**	**16.5**	**18.0**	**14.5**	**12.5**
1992	**16.0**	**20.0**	**20.0**	**19.5**	**15.0**	**14.0**
Minimum						
1989		2.0	3.0	5.0	4.5	4.0
1990		2.0	3.5	4.5	5.0	1.0
1991			4.5	4.0	3.0	0.0
1992	1.0	3.5	5.0		2.5	
1989	**3.5**	**5.0**	**7.5**	**8.5**	**6.0**	**2.0**
1990	**3.5**	**5.0**	**8.0**	**9.0**	**8.0**	**3.5**
1991		**4.5**	**8.5**	**9.0**	**6.5**	**1.5**
1992	**5.0**	**9.5**	**12.0**	**9.0**	**7.0**	**4.5**
Mean						
1989		3.5	6.4	7.1	6.7	6.8
1990		4.3	7.5	7.8	6.8	3.3
1991			7.1	8.0	6.0	3.8
1992	4.6	7.3	7.7		5.2	
1989	**5.8**	**7.9**	**10.8**	**11.6**	**9.3**	**6.6**
1990	**6.0**	**8.2**	**13.1**	**13.4**	**11.5**	**6.4**
1991		**7.8**	**12.3**	**13.6**	**10.6**	**6.8**
1992	**9.6**	**14.0**	**15.3**	**14.3**	**10.7**	**8.8**

Eightmile Creek (Headwaters and **Forest boundary** sites)

	May	June	July	August	September	October
Maximum						
1989	5.5	7.5	8.5	9.0	8.0	6.5
1990	5.5	9.0	9.5	10.5	9.5	9.0
1991		7.5	9.5	9.5	8.0	8.0
1992	8.5	11.0	15.0	14.0	11.0	10.0
1989	**8.5**	**12.0**	**13.5**	**15.0**	**11.0**	**9.5**
1990	**8.5**	**12.5**	**15.5**	**17.0**	**13.5**	**10.5**
1991		**11.0**	**15.0**			**12.0**
1992		**17.0**	**17.0**	**16.5**	**13.0**	**11.0**
Minimum						
1989	1.5	2.5	3.5	4.0	3.0	1.0
1990	1.0	2.5	3.0	4.5	5.0	1.5
1991		2.0	3.5	3.0	2.5	0.0
1992	1.5	3.5	5.0	5.5	4.0	2.0
1989	**3.5**	**6.0**	**7.5**	**9.0**	**6.5**	**1.5**
1990	**3.5**	**5.0**	**8.0**	**9.0**	**8.5**	**3.5**
1991		**4.5**	**9.0**			**1.0**
1992		**8.0**	**10.0**	**8.0**	**6.5**	**3.0**
Mean						
1989	2.6	4.7	5.5	6.0	5.4	4.0
1990	3.0	4.8	6.5	7.6	7.6	4.7
1991		4.3	6.3	7.1	5.9	3.5
1992	4.7	6.5	8.8	9.9	7.8	5.9
1989	**5.7**	**8.8**	**10.7**	**11.6**	**9.2**	**6.2**
1990	**5.9**	**8.8**	**12.6**	**13.0**	**11.2**	**6.0**
1991		**7.8**	**12.3**			**7.0**
1992		**12.2**	**12.9**	**12.8**	**9.6**	**6.8**

Ramsey Creek (Headwaters and **Forest boundary** sites)

	May	June	July	August	September	October
Maximum						
1989	7.0	6.0	6.0	6.0	6.0	5.5
1990	6.0	6.0	6.5	6.5	6.0	6.0
1991		6.0	7.0	7.5	8.5	8.0
1992	7.0					
1989	**9.5**	**12.5**	**13.5**	**14.0**	**9.5**	**8.0**
1990	**9.5**	**13.5**	**15.0**	**16.0**	**12.5**	**9.5**
1991		**12.0**	**14.5**	**15.5**	**12.5**	**10.5**
1992	**12.5**	**16.5**	**16.0**	**15.5**	**11.5**	**9.5**

Ramsey Creek (Continued)

Minimum						
1989	2.0	4.0	4.5	4.5	4.5	3.5
1990	3.5	4.0	4.5	4.5	5.0	3.5
1991		3.5	4.5	5.0	6.0	4.5
1992	4.0					
1989	**4.0**	**6.0**	**7.0**	**7.5**	**5.0**	**1.5**
1990	**3.5**	**4.5**	**7.5**	**7.0**	**6.5**	**2.5**
1991		**5.0**	**8.5**	**8.5**	**5.5**	**1.0**
1992	**4.0**	**6.5**	**8.5**	**6.5**	**5.0**	**2.0**
Mean						
1989	4.9	5.1	5.2	5.2	5.0	4.5
1990	4.4	5.0	5.6	5.5	5.4	4.5
1991		4.7	5.6	6.4	7.0	6.6
1992	5.3					
1989	**6.2**	**9.2**	**10.2**	**10.1**	**7.8**	**5.4**
1990	**6.2**	**9.0**	**11.4**	**11.6**	**9.6**	**5.2**
1991		**8.2**	**11.7**	**12.3**	**9.2**	**6.0**
1992	**8.3**	**11.0**	**11.5**	**11.2**	**8.3**	**5.8**

Fivemile Creek (**Forest boundary** site)

	May	June	July	August	September	October
Maximum						
1989	**9.0**	**13.0**	**14.5**	**16.0**	**12.5**	**10.0**
1990	**8.5**	**12.5**	**16.0**	**18.0**	**14.5**	**11.0**
1991		**11.0**	**15.5**	**17.5**	**14.5**	**12.5**
1992		**17.5**	**18.5**		**15.5**	**11.5**
Minimum						
1989	**5.0**	**7.0**	**8.5**	**9.5**	**6.5**	**2.0**
1990	**4.5**	**6.0**	**8.5**	**9.5**	**8.0**	**3.5**
1991		**5.5**	**8.5**	**9.0**	**6.5**	**1.5**
1992		**8.5**	**11.5**		**5.5**	**0.5**
Mean						
1989	**6.6**	**9.6**	**11.2**	**12.3**	**9.7**	**6.7**
1990	**6.4**	**8.8**	**12.7**	**13.5**	**11.6**	**6.5**
1991		**8.0**	**12.0**	**13.8**	**11.0**	**7.0**
1992		**12.6**	**14.6**		**9.8**	**6.8**

APPENDIX C

Selected photographs taken of the 1992 Ramsey Creek project area (section one).

Helicopter delivering log to section one (top) and spyder excavator moving log for placement in Ramsey Creek (bottom).

Before (top) and after (bottom) construction photos of site 28; photographer is standing upstream.

Before (top) and after (bottom) implementation photos of site 28 taken from downstream. The post implementation photo was taken from further away than the pre implementation photo.

Pre and post implementation shots of site 24 taken from upstream. Post implementation photo was taken from a slightly different angle.

Pre and post implementation photos of site 23 taken from upstream. This site was one of our more intensive debris loading efforts.

Pre implementation photo of site 8 (top) and post implementation photo of sites 8 (foreground) and 9 (background). Apparent lack of riparian vegetation in bottom photo due in large part to the photo timing after leaf drop.